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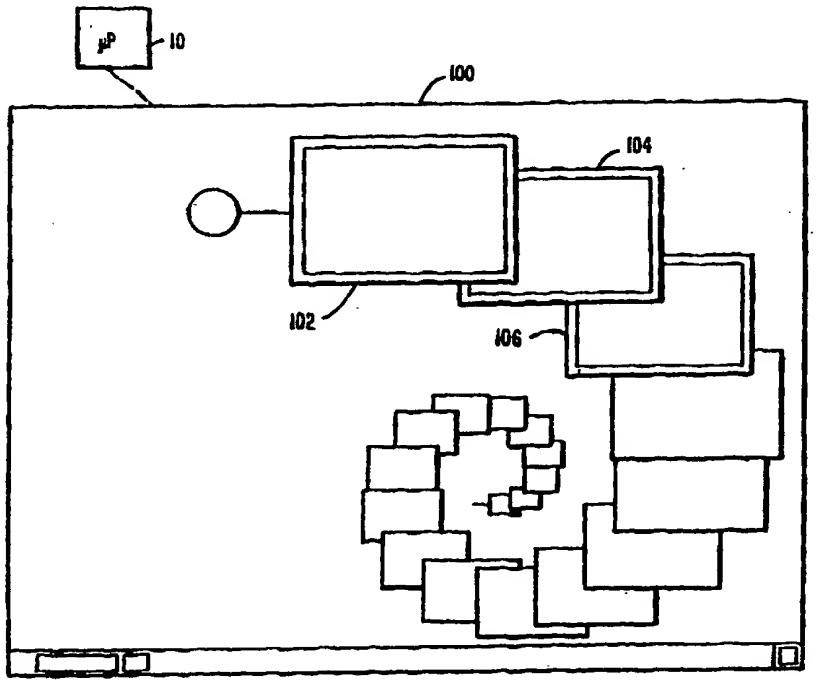
(54) Title: DISPLAY OF MULTIPLE IMAGES BASED ON A TEMPORAL RELATIONSHIP AMONG THEM WITH VARIOUS OPERATIONS AVAILABLE TO A USER AS A FUNCTION OF THE IMAGE SIZE

(57) Abstract

Multiple images (102, 104, 106) are displayed on a screen (100) of a computer system (Fig. 1) to reflect a temporal relationship among them. Based on date and time when an image is obtained in relation to other displayed images, its size is set accordingly. Namely, the more recent the image, the larger its size on the screen (100). In addition, the larger the size of the image, the more processing operations, including graphical or text processing functions, are available to a user to be performed on that image.



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DISPLAY OF MULTIPLE IMAGES BASED ON A TEMPORAL RELATIONSHIP AMONG THEM WITH VARIOUS OPERATIONS AVAILABLE TO A USER AS A FUNCTION OF THE IMAGE SIZE

BACKGROUND OF THE INVENTION

The invention is related to a Graphical User Interface (GUI) and, in particular, a method for displaying on a computer screen images which are temporally related to each other, indicating the temporal relationship among them, while optionally supplying the displayed images with various levels of functionality based-on their displayed size.

As well known in the art, a Graphical User Interface allows a user of a computer system to view, manipulate, etc. images on a screen in a simple and user-friendly manner. The displayed images may be graphical or textual. As complexity and functionality of computer systems increase, however, the limited display area of the computer screen becomes a highly valuable "commodity." Clearly, the display area must be utilized wisely to accommodate the increased system complexity, as correctly pointed out in the U.S. Patent No. 5,341,466 to Perlin et al, for example.

In particular, simultaneous display of multiple images on a screen presents somewhat conflicting interests between programmers and users. While the programmers would like to utilize the full capability of the system, which may be quite complex requiring several images to be shown on the screen, they are constrained by the users' desire to have simple and "user-friendly" displays. Understandably, users do not want to be overburdened with a hard-to-understand display even if it offers increased system functionality.

Undoubtedly, the currently popular windows environment provides the vehicle to partially reconcile those conflicting interests. A multiple image display with

various functionalities is accomplished on one screen without sacrificing the "user-friendliness" of the system. Users have immediate access to several applications, for example, and can switch between them with ease and simplicity.

Nevertheless, the display of temporally-related windows is currently deficient in several aspects. Namely, the display of those windows created, i.e., "opened", prior to the currently active open window is substantially hidden from view, appearing stacked behind the current window. Alternatively, multiple windows may be fully visible to a viewer, i.e., occupying substantially the same or smaller display areas on the screen for example, but fail to indicate to the viewer the existence of a temporal relationship between them.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide a display of multiple images such that a temporal relationship among the displayed images is clearly visible to a viewer.

It is another object of the present invention to provide a display of multiple images having various sizes as a function of date and time of creation of each displayed image, such that a temporal relationship among the images in the displayed windows is clearly visible to a viewer.

It is a further object of the present invention to provide a display of multiple pages in a document, such that the displayed pages are shown in increasingly smaller sizes as the date and time of creation of each displayed page becomes further removed in time from the most recently created page having the largest image display on the screen.

It is still another object of the present invention to provide a display of multiple images having different functions or operations available to a user based

on the size of the displayed window image.

It is yet a further object of the present invention to provide a display of multiple pages in a document, such that when the displayed image is increased or reduced in size, its functionality, i.e., the displayed image operations available to a user, increases or decreases, correspondingly.

It is yet another object of the present invention to provide a display of multiple pages in a document, such that a page having a smaller display size has less functions available to a user than a page with a larger display size.

SUMMARY OF THE INVENTION

These and other objects, features and advantages are accomplished by a method and system for displaying images on a screen. A temporal order of the images is determined first, and one of them is designated as a first image. The images are displayed sequentially in the temporal order such that the first image has the largest size among the displayed images.

In accordance with one aspect of the present invention, the temporal order indicates an order in which the images have been obtained by the computer system. The sizes of those images which are older than the first image progressively change in accordance with the temporal order such that the size of an older image is smaller than the size of a newer image.

In accordance with another aspect of the present invention, the images are connected to each other on the screen by a curved line representing two spiral chains which are also connected to each other. The first image is located at a connecting point of the two spiral chains, wherein the images which are older than the first image are connected by one spiral chain and those images which are newer than the first image are connected by another spiral chain.

In accordance with yet another aspect of the present invention, those images which are newer in the temporal order than the first image are not displayed on the screen.

In accordance with still another aspect of the present invention, the displayed images exhibit different sizes and are subject to a number of processing operations by a user. The number of processing operations, including either a graphical or text processing operation, available to the user to be performed on each image is dependant upon each image size: a fewer number of the processing operations are available to be performed on a smaller image than on a larger image.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned as well as additional objects, features and advantages of the present invention will become readily apparent from the following detailed description thereof which is to be read in conjunction with the accompanying drawings, in which:

Fig. 1 is a computer screen display of multiple, various-sized images arranged in a spiral chain to indicate a temporal relationship among them according to one embodiment of the present invention.

Fig. 2 is a computer screen display of multiple, various-sized images arranged in a web spiral chain to indicate a temporal relationship among them according to another embodiment of the present invention.

Fig. 3 is a computer screen display of multiple, various-sized images arranged as two spiral chains connected to each other to indicate a temporal relationship among the displayed images according to yet another embodiment of the present invention.

Fig. 4 is a sequencing flowchart for displaying temporally-related images in accordance with one aspect of the present invention.

Fig. 5 is a sequencing flowchart for displaying

temporally-related images in accordance with another aspect of the present invention.

Fig. 6A is a computer screen display of an image having a predetermined number of operations available to be performed on that image as a function of the image display size according to one aspect of the present invention.

Fig. 6B is a computer screen display of the image of Fig. 6A increased in size and having a larger number of operations available than in Fig. 6A.

Fig. 6C is a computer screen display of the image of Fig. 6B further increased in size and having even larger number of operations available than in Fig. 6B.

Fig. 7 is a sequencing flowchart for displaying computer screen images having various functionalities as a function of their display size in accordance with one aspect of the present invention.

Fig. 8 is a graph illustrating the process of scalable functionality as described with reference to Fig. 7.

In all Figures, like reference numerals represent the same or identical components of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will now be explained in detail with reference to the accompanying drawings.

Fig. 1 shows a computer screen display of multiple, various-sized images according to the present invention. The images are arranged in a spiral chain on screen 100 to indicate a temporal relationship among them. Namely, image 102 has the largest display size and is the most recent image, as indicated by its display size on the screen 100. Image 104 is the next most recent image, as indicated by its size being smaller than the image 102. Similarly, image 106 is less recent than the image 104, and the size of each additional image in Fig. 1 is displayed according to its temporal relationship to other images.

When a user desires to view a new image on the

screen 100, that image will be sized according to its date and time of creation, for example, and will occupy its appropriate position within the spiral chain. That is, if the most recent image is added to the display, that new image takes on the size of the image 102. The image 102, in turn, becomes the size of the image 104, which is decreased to the size of the image 106. In other words, with the addition of the new image, all images are re-sized accordingly to indicate the proper temporal relationship among them.

The definition of "the most recent" may include date and time of creation of a page in a document, as assumed in the preceding discussion for example. That is, let it be assumed a user creates a multi-page document using word-processing software, for example, and then wishes to review all or several pages of that document on the screen. In accordance with the present invention, the pages of the document are displayed on the screen in various sizes according to the date and time of creation of each page. The more recent the page in the document, the larger it appears on the screen.

Alternatively, the images may be arranged according to the time the user retrieved them from a database or the Internet, for example. In particular, the user may obtain several textual images, i.e., documents, from a commercial on-line content provider and he/she then may obtain several images from the Internet which are related to the retrieved text. When viewing all of the obtained images related to the particular subject, for example, the user arranges the images on the screen according to their time of retrieval, i.e., the textual images retrieved prior to the graphical images. As shown, for example, in Fig. 2, textual image 202 appears smaller than graphical image 204 on screen 200 in accordance with the present invention. In addition, all of the displayed images are located on the web spiral chain 206, which also points out the sequencing relationship among the displayed

images.

While the displayed images of different sizes in Fig. 1 are shown overlapping each other, Fig. 2 additionally shows another embodiment of the present invention comprising a computer screen display of multiple, various-sized images arranged in a web spiral chain. In Fig. 2, the web spiral chain indicates a temporal relationship among the displayed images without any screen display area overlap. It is understood, of course, that the spiral chain arrangement in Fig. 1 may include a display of images of various sizes spaced apart from each other such that each image is fully visible to the user.

Fig. 3 shows yet another embodiment of the present invention. Fig. 3 is a computer screen display of multiple, various-sized images arranged as two web spiral chains connected to each other. As in the embodiments described above, the display size of the image indicates a temporal relationship among all of the displayed images on screen 300. Two web spiral chains 302 and 304 are joined by image 306 on which the user currently performs some operation, for example. Those images located on the web spiral chain 302, such as 308, 310, 312, etc., have been created prior to the creation of the image 306. Images 314, 316, 318, etc. located on the web spiral chain 304 have been created subsequently to the image 306.

As shown in Fig. 3, those images on the web spiral chain 302 are displayed in such a manner that the most recent (current) image on that chain is the largest, while the other images on that chain decrease in size depending on their date/time of creation, retrieval, etc. This is in accordance with the above examples described with reference to Figs. 1 and 2. The web spiral chain 304, however, has a reciprocal arrangement with that of the web spiral chain 302: the least recent (least current) image is the largest in size, while the remaining images on the web spiral chain 304 decrease in size as their date/time of creation, retrieval, etc. by the user becomes

more recent or current. That is, the most recent (current) image on the web spiral chain 304 is image 320, the next most recent (current) is image 322, etc. It is understood, of course, that this "reverse" display of temporal relationship among the images located on the web spiral chain 304 may also be used in the examples of Figs. 1 and 2 as described above.

Fig. 4 is a sequencing flowchart for operating a processor to display temporally-related images in accordance with one embodiment of the present invention. Following the start operation in step 400, it is determined in step 402 how "current" the displayed image is. As stated above, the point of reference may be date/time of image creation, date/time of image retrieval into the system, etc. The image is then displayed on the screen in step 404 according to a predetermined size for the first displayed image.

A decision is then made in step 406 whether this is the only image that the user wishes to view on the screen. If so, the operation is terminated as indicated by step 408. Otherwise, i.e., this is not the only image to be displayed, it is determined in step 410 how "current" the next image to be displayed is. A comparison is then carried out in step 412 to determine whether the next "to-be-displayed" image is more current than the displayed image. If so, the size of the displayed image is reduced in step 414, and the reduced displayed image appears on the screen in step 416. If, on the other hand, the next "to-be-displayed" image is less current than the displayed image, then dimensions of the next "to-be-displayed" image are adjusted in step 418 in accordance with a predetermined size which is less than the displayed image size.

The process then continues with step 420 where the next "to-be-displayed" image is displayed on the screen, either larger or smaller than the previous image based on how current it is as described above. In step 422, the two displayed images on the screen are connected

to each other by a web spiral chain or an ordinary spiral chain.

Next, a decision is made in step 424 to determine whether there are more images to be displayed on the screen. If so, the process is stopped in step 408. Otherwise, the display of the next image continues with step 410 and subsequent steps as described above.

Fig. 5 is a sequencing flowchart representing the operation of a processor to display temporally-related images in accordance with another aspect of the present invention and, in particular, the "reverse" arrangement as represented by the web spiral chain 304. The flowchart of Fig. 5 is partly similar to the flowchart of Fig. 4 and since steps 400, 402, 404, 406, 408, 410, 420, 422 and 424 fully correspond to steps 500, 502, 504, 506, 508, 510, 520, 522 and 524 respectively, their description will be omitted for the sake of clarity. Only those steps in Fig. 5 which differ from steps in Fig. 4 will be described next.

Hence, starting with the description of step 512 in Fig. 5, if it is determined that the next "to-be-displayed" image is more current than the displayed image, the size of the next "to-be-displayed" image is made in step 514 to conform to a predetermined size which is less than the displayed image size. If, on the other hand, the next "to-be-displayed" image is less current than the displayed image, then the displayed image is reduced in step 516, and the reduced displayed image appears on the screen in step 518. The process then continues as described above with reference to Fig. 4.

Figs. 6A, 6B and 6C further show an aspect of the present invention to provide a more user-friendly display and to improve a memory management capability in the computer system. In particular, Fig. 6A is a computer screen display of several images. Only part of image 602 appears on screen 600, while entire image 604 and substantially entire image 606 are displayed as shown in the figure.

In accordance with one aspect of the present invention, only certain functions (operations) are available to the user at this particular image scale, i.e., at this size, because the scale is relatively small. That is, the user can, for example, select an object in the image 604, move or change the size of that object, or copy or delete it. Other more detailed operations dealing, for example, with the contents of the object, are unavailable to the user due to the small image scale on the display screen. Referring to the above example, with multiple pages in the document created by using word processing software, at this scale the user may be permitted to use only selected operations of the word processing software: to indent paragraphs, to justify text by specifying the line alignment with respect to left and right margins, to convert upper/lower case letters, as well as other large-scale functions. This is so because individual words or letters cannot be recognized by the user due to the small image scale, as stated above.

Fig. 6B shows a computer screen display of image 604 increased in size. Namely, by selecting via a cursor and "clicking" on the image 604 in Fig. 6A using a conventional input device, such as a mouse, the image 604 is increased in size. Since the user can now view more of the contents of each object due to this larger scale, more operations become available than in Fig. 6A.

For example, image functionality at this scale may include editing of the object's title, changing graphical images within the object, etc. In a multiple page document created with word processing software, the user may scroll through the text, cut, copy and paste paragraphs, etc.

Fig. 6C is the next computer screen display of the image 604 further increased in size and having an even larger number of operations available to it than in Fig. 6B. Full scale image functionality, for example, may become available to the user since the image 604 now

occupies substantially the entire display area of the screen.

Fig. 7 is a sequencing flowchart representing the operation of a processor to display the images having various functionalities as a function of their display sizes, in accordance with one aspect of the present invention. After the start in step 700, an image is displayed with a predetermined scale and predetermined manipulable function in step 702. A decision is then made in step 704 whether the displayed image has the maximum or minimum scale as defined by the system and screen display area. If so, the process returns to the display of that image in step 702 without any further operation. If, however, the displayed image is not at the maximum or minimum scale, the image scale is changed in step 706, i.e., decreased or increased according to the user input, temporal relationship of the image with respect to other images, etc.

Next, a decision is made in step 708 whether the image scale has been increased. If so, another decision is made in step 710 whether the maximum level of functionality has been reached at this image scale. If the answer is negative, the level of functionality is increased in step 712 making more operations pertaining to that displayed image available to the user. The process is then stopped in step 718. Otherwise, that is, if the image has the maximum level of functionality allowed by the system, the process returns to step 702 to display the increased image without any change in the image functionality.

If in step 708, it is decided that the image has been decreased in step 706, another decision is carried out in step 714 to determine whether the image has the minimum level of functionality. If so, the process returns to step 702 and displays the decreased image without any modifications to its level of functionality. Otherwise, that is, if the image is not associated with the minimum level of functionality, the level of functionality is

decreased in step 716 making less operations available to the user with respect to that particular image display.

Fig. 8 is a graph illustrating the process of scalable functionality as described with reference to Fig. 7. As shown in Fig. 8, the x-axis represents the displayed image scale while the y-axis represents the level of functionality for the displayed image. When the image scale increases from **x** to **x + a**, the level of functionality also increases from **y** to **y + b**. If the next predetermined scale for the image display is reached, the level of functionality increases correspondingly. Similarly, when the image is scaled down, the number of operations available to the user to perform on that image, i.e., the level of functionality, decreases to the adjacent lower level, if any.

By further observing the graph of Fig. 8, it is worth noting that both the scale and functionality have minimum and maximum levels as defined by the system and/or system programmers. Furthermore, both the scale and level of functionality are not continuous but discrete: the level of functionality does not change from the previous level until the scale reaches the next predetermined value to effect the image change if allowed.

The scalable image functionality can be optionally activated with the spiral display of temporally related images described above. Based on the image size indicating how recent (current) the image is, the number of word processing operations may change as, for example, when the user views a multiple page document on the screen and performs various operations on the contents of individual pages.

It is also worth noting that the scaled image functionality improves the system memory management. Namely, those functions which are not relevant to the particular image scale do not have to be loaded into the system memory. This is in contrast to conventional image displays where all functions are pre-loaded into system

memory, even though many functions are useless at all image scales except the full scale. Hence, the system memory is unnecessarily wasted in conventional image displays.

Figs. 1-3 and 6A-6C show the respective display screens under the control of microprocessor 10. It will be appreciated that the microprocessor 10 or any other programmable controller may be programmed to effect the operations of the present invention as described above with reference to those figures and in accordance with the flowcharts of Figs. 4, 5 and 7.

Having described specific preferred embodiments of the invention with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or the spirit of the invention as defined in the appended claims.

CLAIMS

What is claimed is:

1. A method for displaying a plurality of images in a computer system, comprising the steps of:

determining a temporal order of said images;

designating one of said images as a first image; and

displaying said images sequentially in said temporal order such that said first image has the largest size among said images.

2. The method according to claim 1, wherein said temporal order indicates an order in which said images have been retrieved by said computer system.

3. The method according to claim 2, wherein said images exhibit different sizes, and the sizes of those images which are older in said temporal order than said first image successively change in accordance with said temporal order such that the size of an older one of said images is smaller than the size of a newer one of said images.

4. The method according to claim 3, wherein the sizes of those images which are newer in said temporal order than said first image successively change in accordance with said temporal order such that the size of an older one of said images is larger than the size of a newer one of said images.

5. The method according to claim 4, wherein said images are displayed as being connected by a curved line representing two spiral chains which are connected to each other, wherein said first image is located at a connecting point of said two spiral chains, wherein said images which are older in said temporal order than said first image are connected by one of said two spiral chains and wherein said images which are newer in said temporal order than said

first image are connected by the other of said two spiral chains.

6. The method according to claim 3, wherein those images which are newer in said temporal order than said first image are not displayed.

7. The method according to claim 6, wherein said images are displayed as being connected to each other by a curved line representing a spiral chain, wherein said first image is located at an outer end of said spiral chain.

8. The method according to claim 2, wherein the displayed images exhibit different sizes and are subject to a number of processing operations by a user; and the number of processing operations, including either a graphical or text processing operation, available to said user to be performed on each of said images is dependant upon the size of each of said images.

9. The method according to claim 8, wherein a fewer number of said processing operations are available to said user on a smaller one of said images than on a larger one of said images.

10. The method according to claim 1, wherein said temporal order is in accordance with an editing operation that has been performed by a user.

11. The method according to claim 10, wherein said images exhibit different sizes, and the sizes of those images which are older in said temporal order than said first image successively change in accordance with said temporal order such that the size of an older one of said images is smaller than the size of a newer one of said images.

12. The method according to claim 11, wherein the sizes of

those images which are newer in said temporal order than said first image progressively change in accordance with said temporal order such that the size of an older one of said images is larger than the size of a newer one of said images.

13. A method for displaying images on a screen in a computer system based on a temporal relationship among said images which are stored in said computer system, comprising the steps of:

determining date and time when a first image in a first plurality of images has been obtained by said computer system;

displaying said first image having a predetermined display area on said screen;

determining date and time when a second image in said first plurality of images has been obtained by said computer system;

comparing date and time of said first and second images;

reducing said first image size only if said second image is more recent than said first image and displaying said reduced first image on said screen; and

displaying on said screen said second image in said predetermined display area which is larger than said first image size if said first image has been reduced by the previous step, and otherwise making said second image smaller than said first image and displaying said second image on said screen, wherein the temporal relationship between said first and second images is readily discernible.

14. The method according to claim 13, wherein said first and second images are connected to each other on said screen by a curved line representing a spiral chain, wherein said second image is located at a beginning of said spiral chain and said first image is located after said

second image on said spiral chain.

15. The method according to claim 14, wherein said spiral chain is a first web spiral chain.

16. The method according to claim 15, further comprising a second plurality of images located on a second web spiral chain displayed on said screen, each image on said second web spiral chain being of different display size such that the least current image has the largest display size on said screen, and said second web spiral chain is connected to said first web spiral chain.

17. The method according to claim 16, wherein said second web spiral chain is connected via its least current image to said first web spiral chain such that the least current image on said second web spiral chain is shared by said first and second pluralities of images such that the least current image in said second plurality of images represents the most current image in said first plurality of images.

18. The method according to claim 13, wherein said images are subject to a number of processing operations by a user; and the number of processing operations including, a graphical or text processing operation available to said user to be performed on one of said first and second images is based on the display size thereof.

19. The method according to claim 18, wherein said first image has a fewer number of processing operations available to said user to be performed on said first image than said second image if said first image is smaller than said second image.

20. A system (Fig. 1) for displaying a plurality of images (102, 104, 106), comprising:

a display screen (100) for displaying said

plurality of images (102, 104, 106); and

a controllable processor (10) programmed to determine a temporal order of said images (102, 104, 106), to designate one (102) of said images (102, 104, 106) as a first image, and to display said images sequentially in said temporal order such that said first image (102) has the largest size among said images (102, 104, 106).

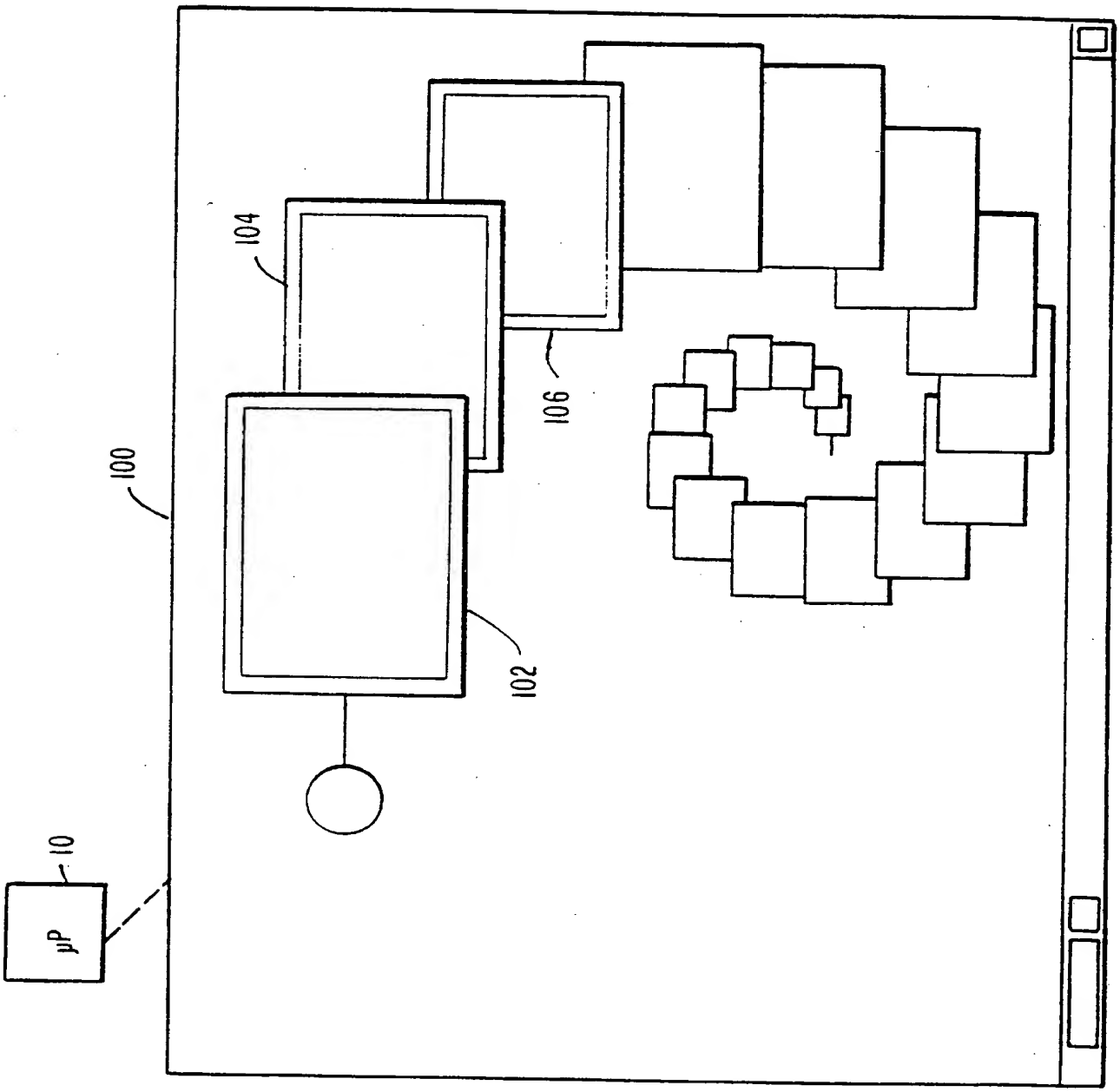


FIG. 1

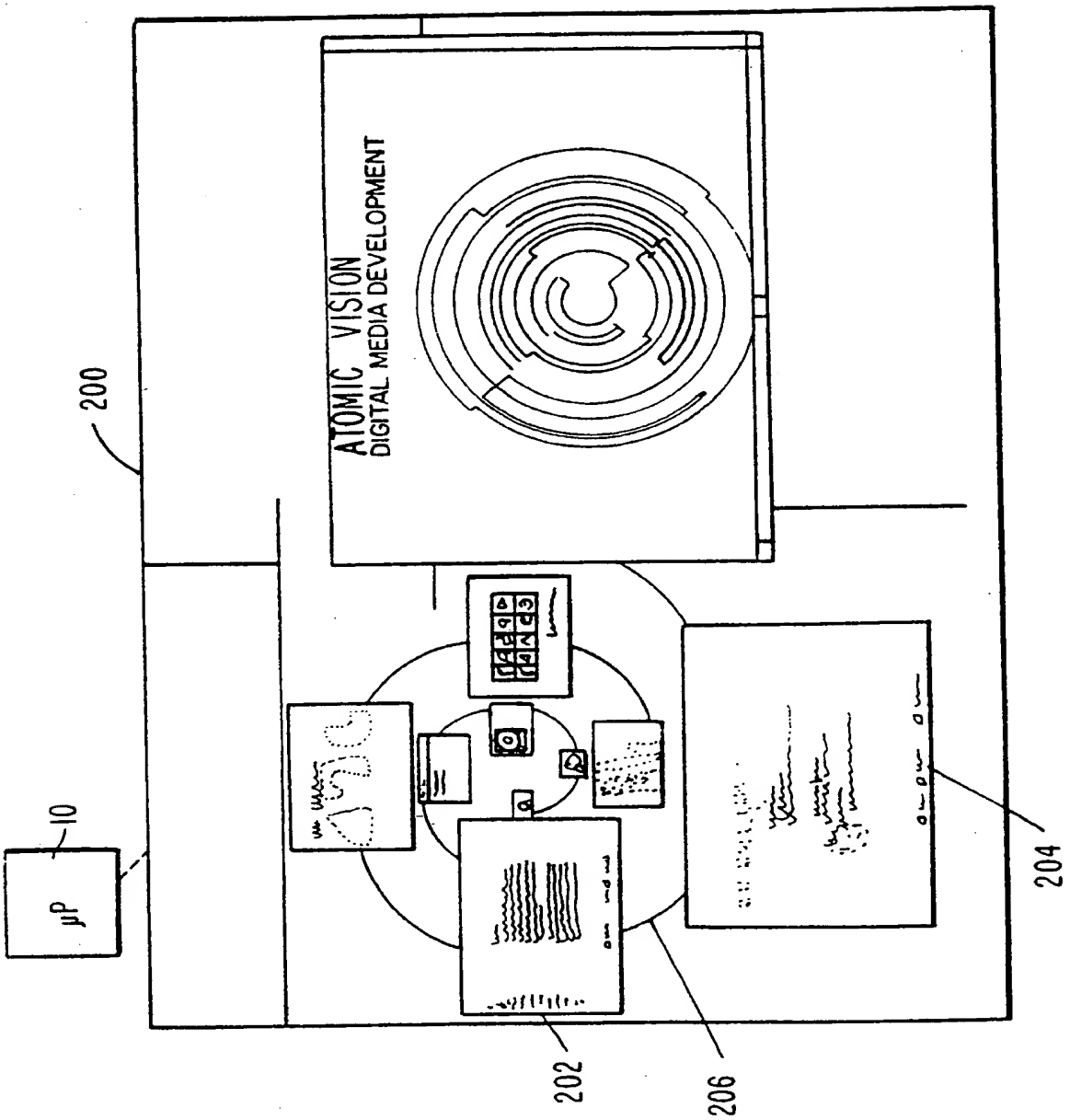
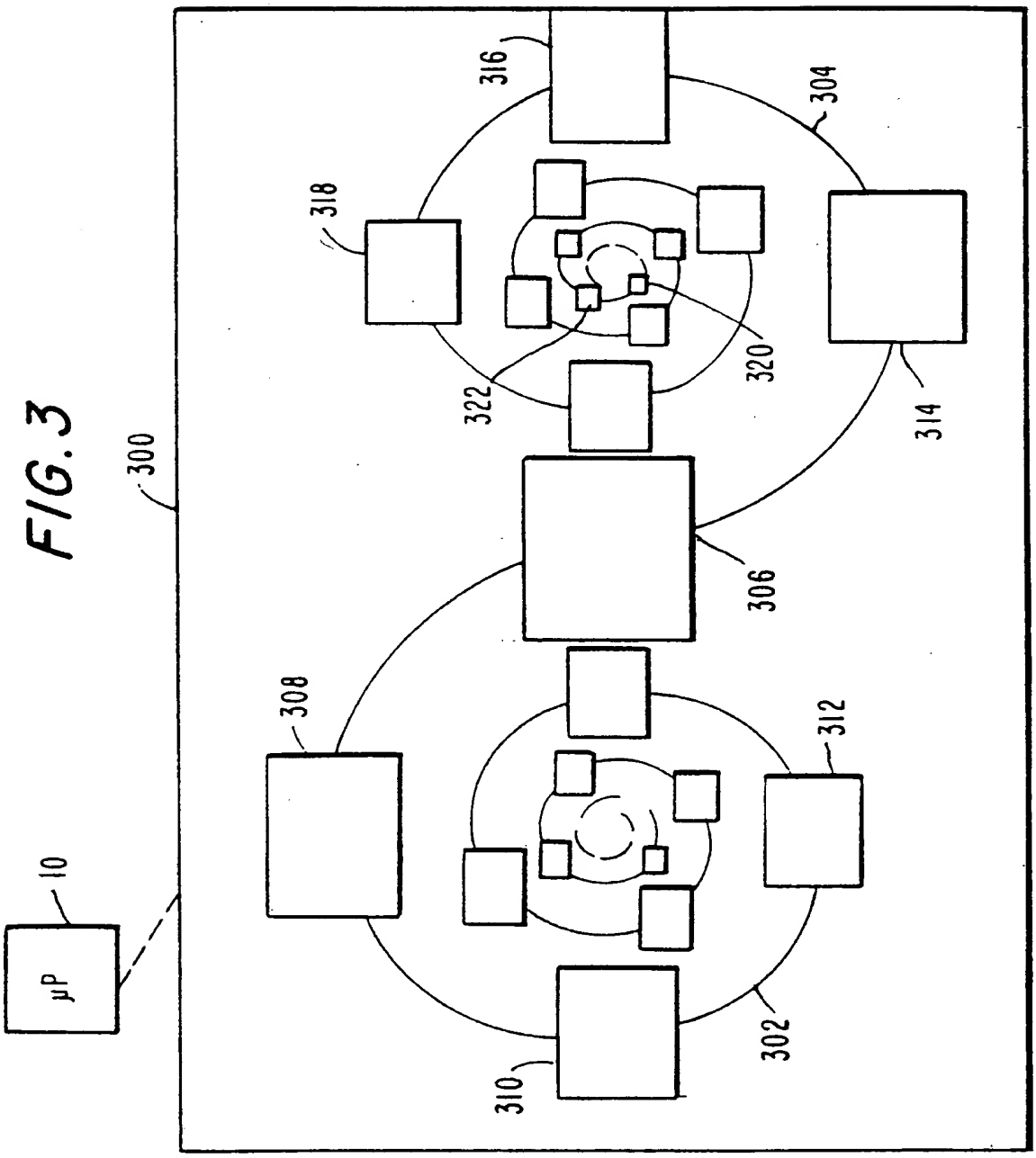


FIG. 2

FIG. 3



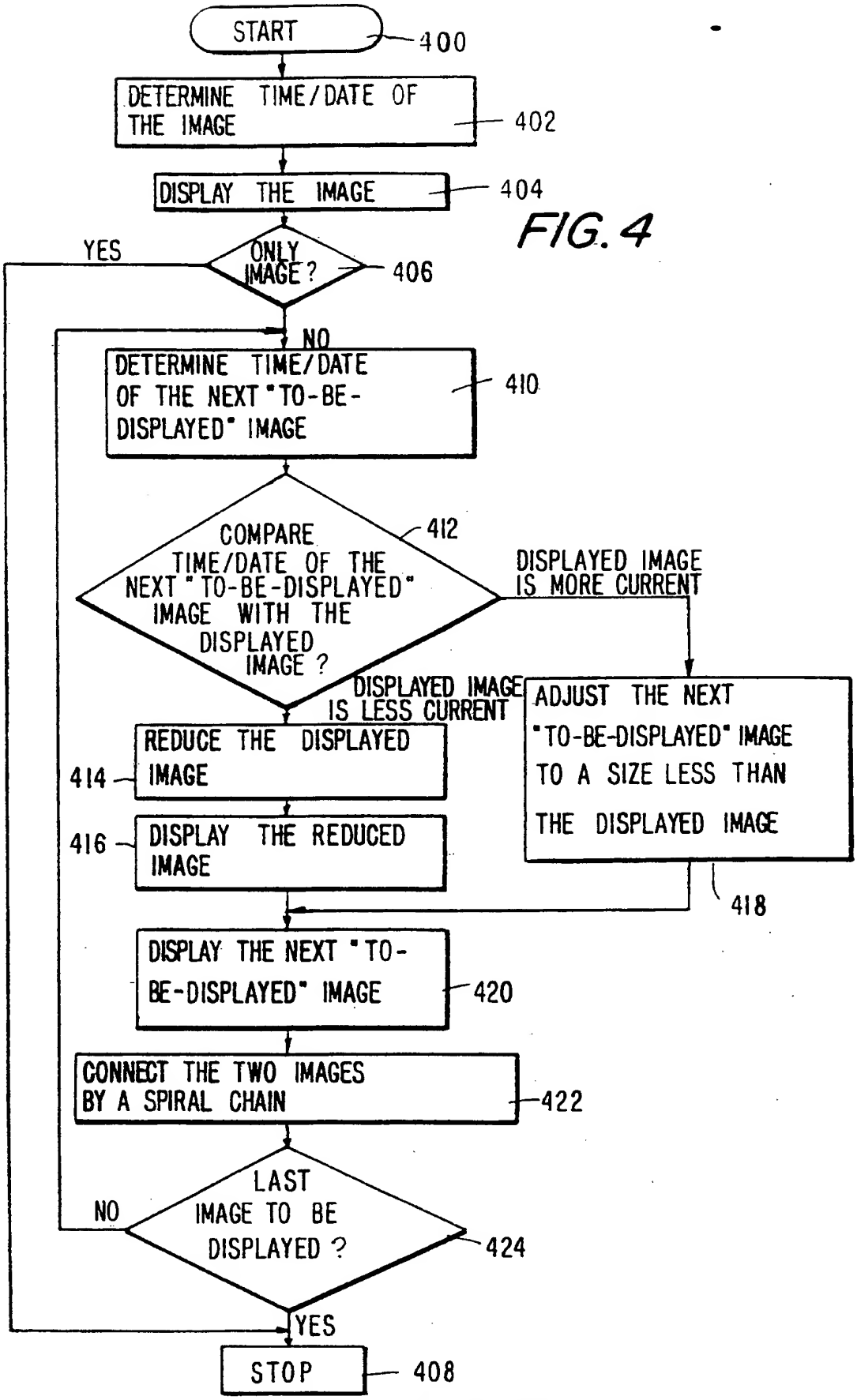


FIG. 4

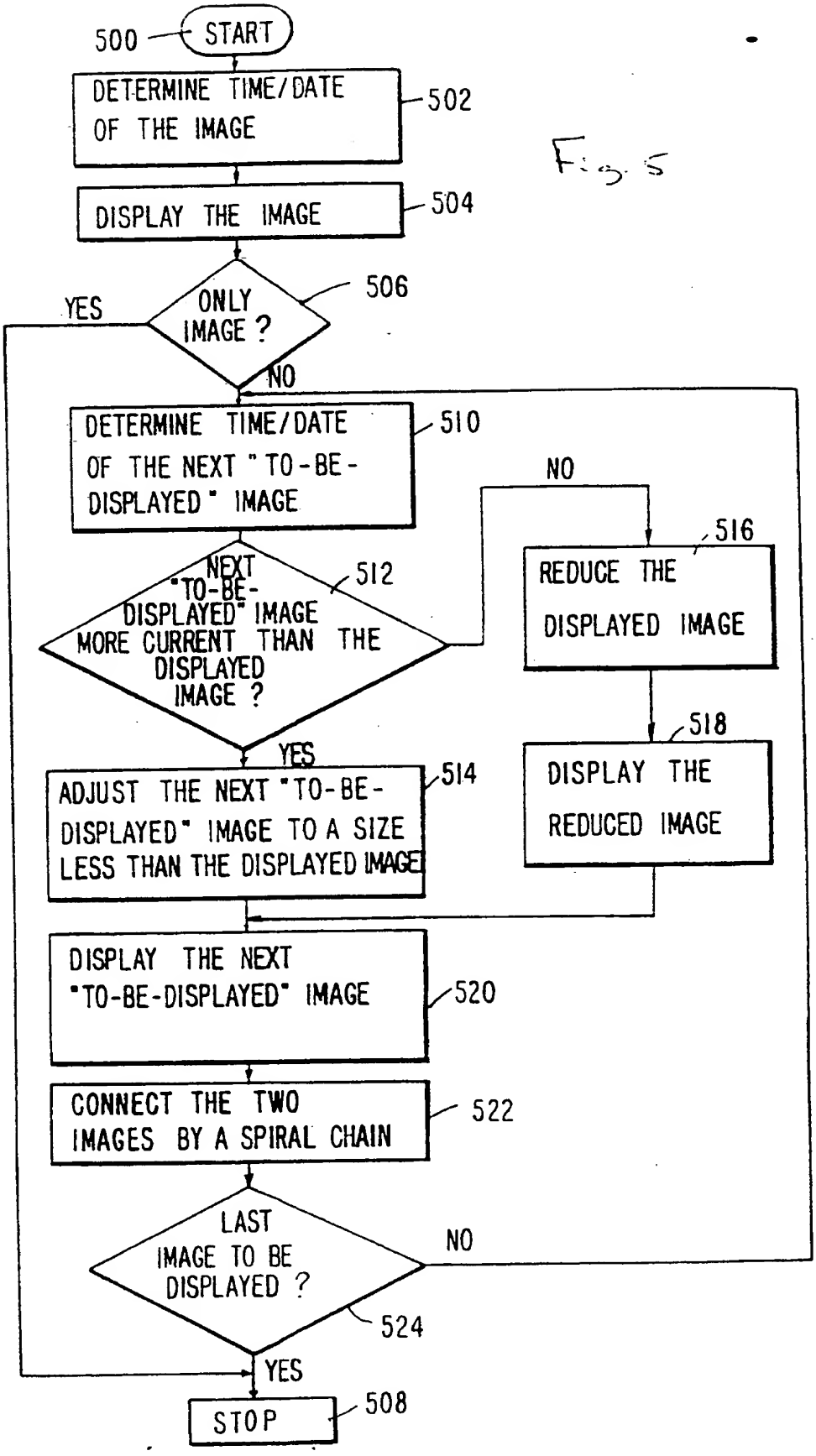


Fig. 5

FIG.6A

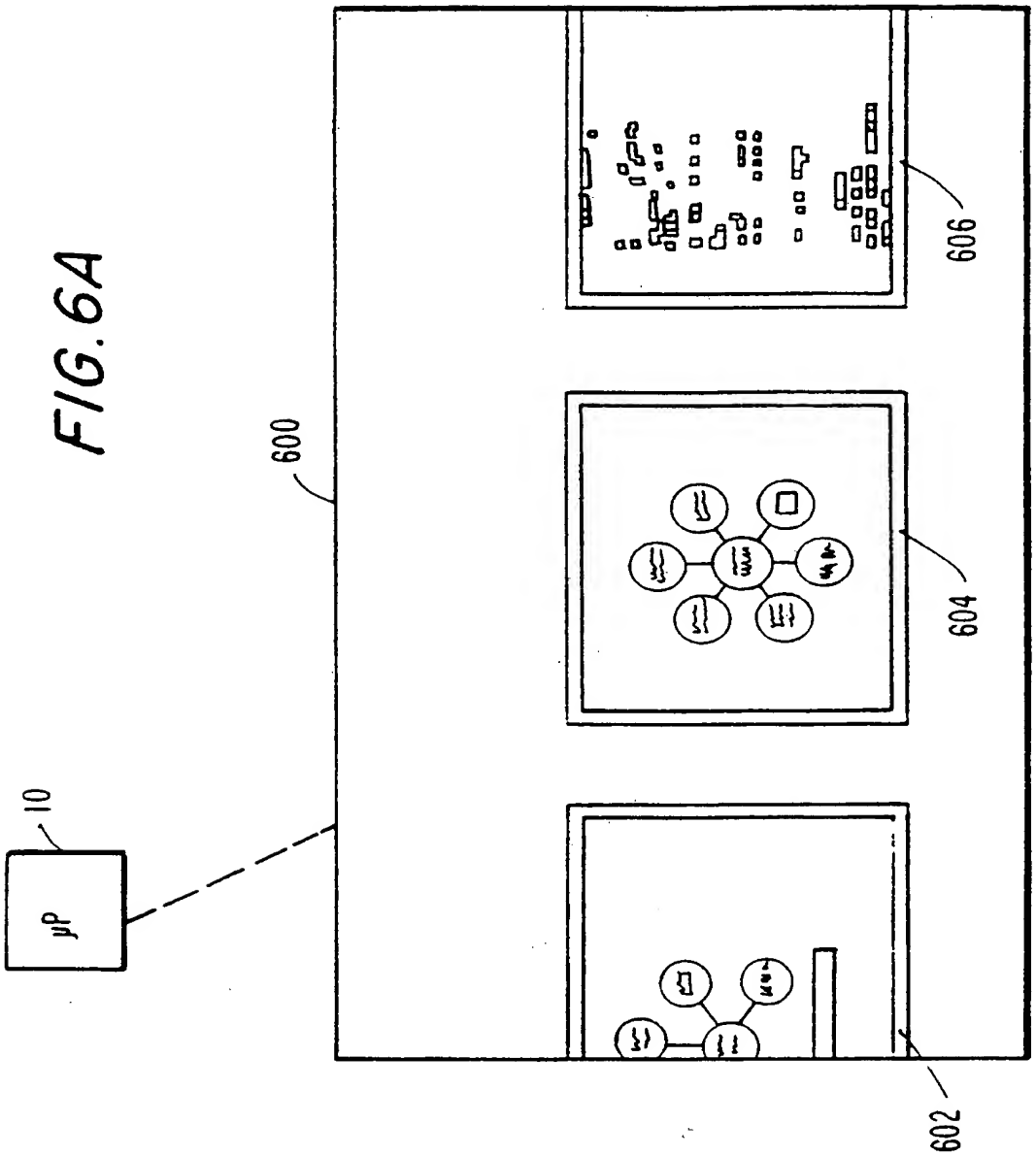


FIG. 6B

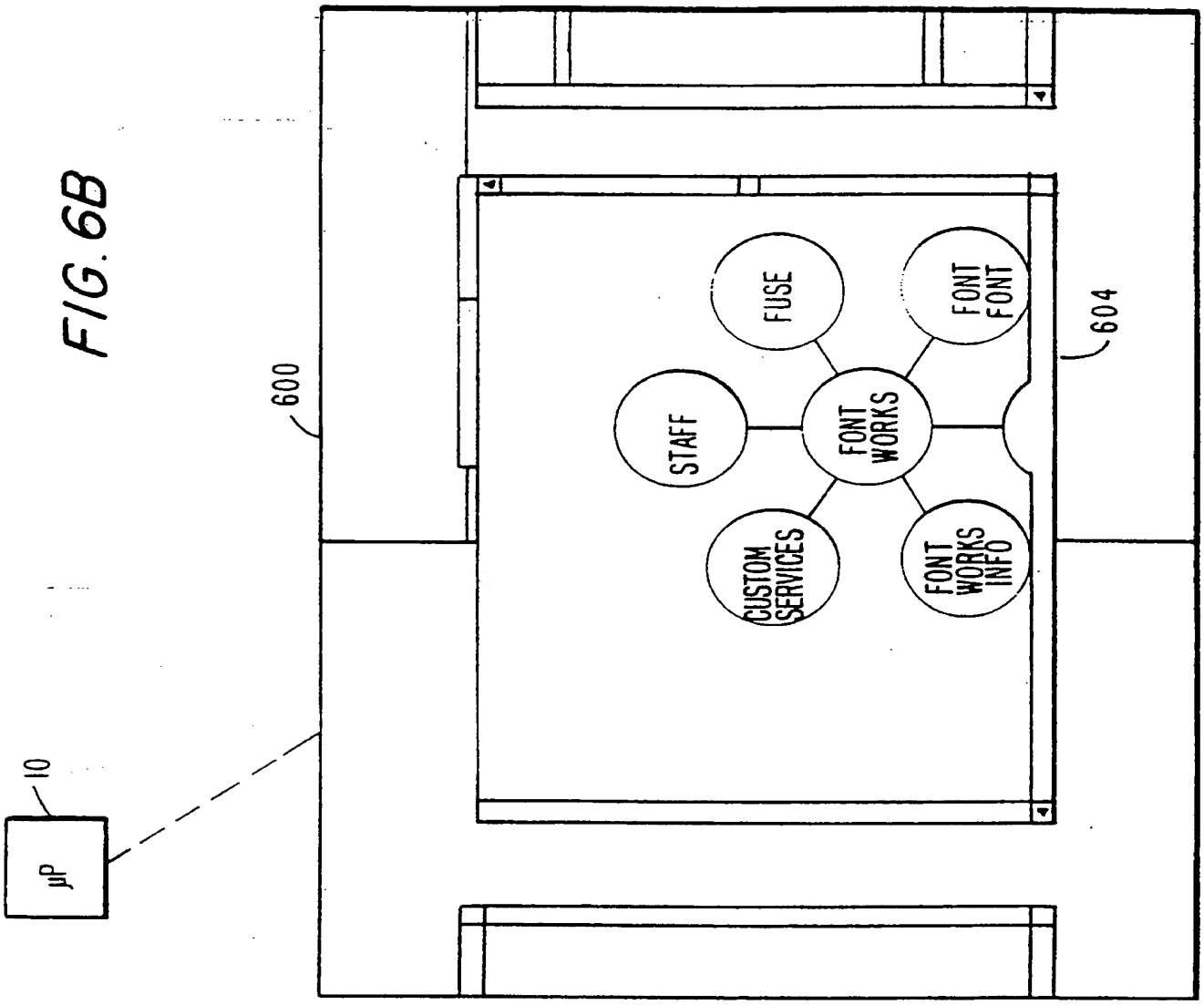
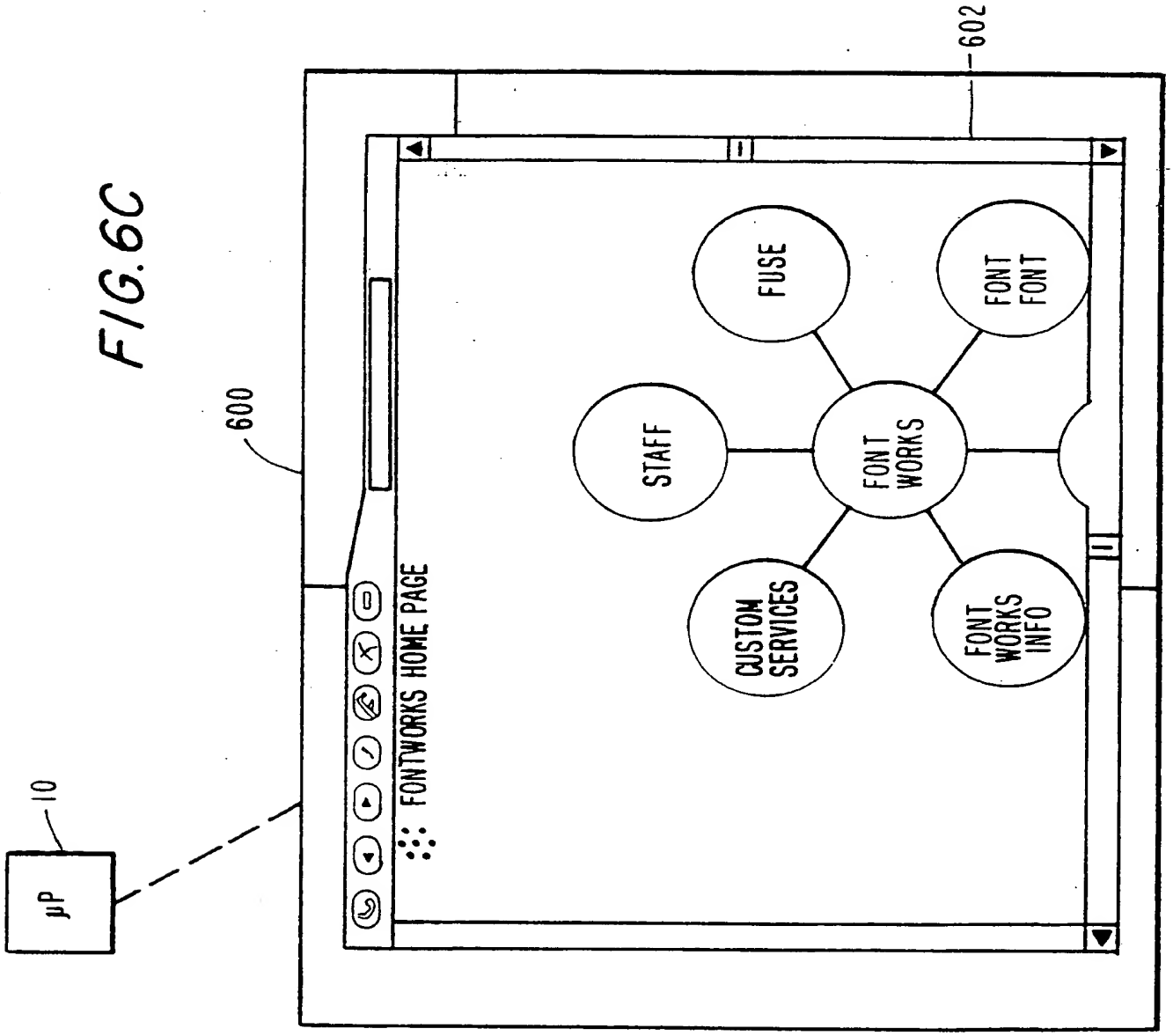


FIG.6C



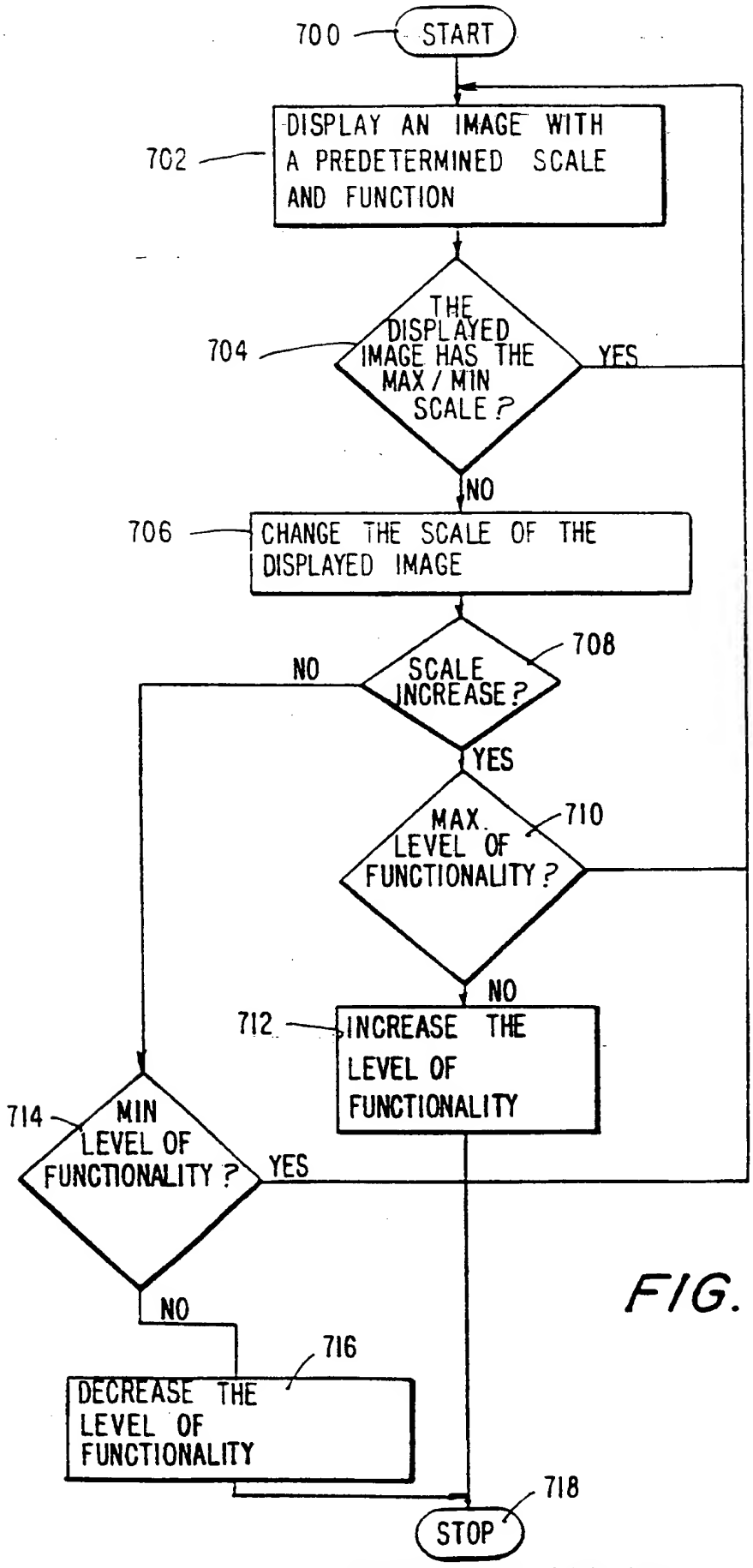
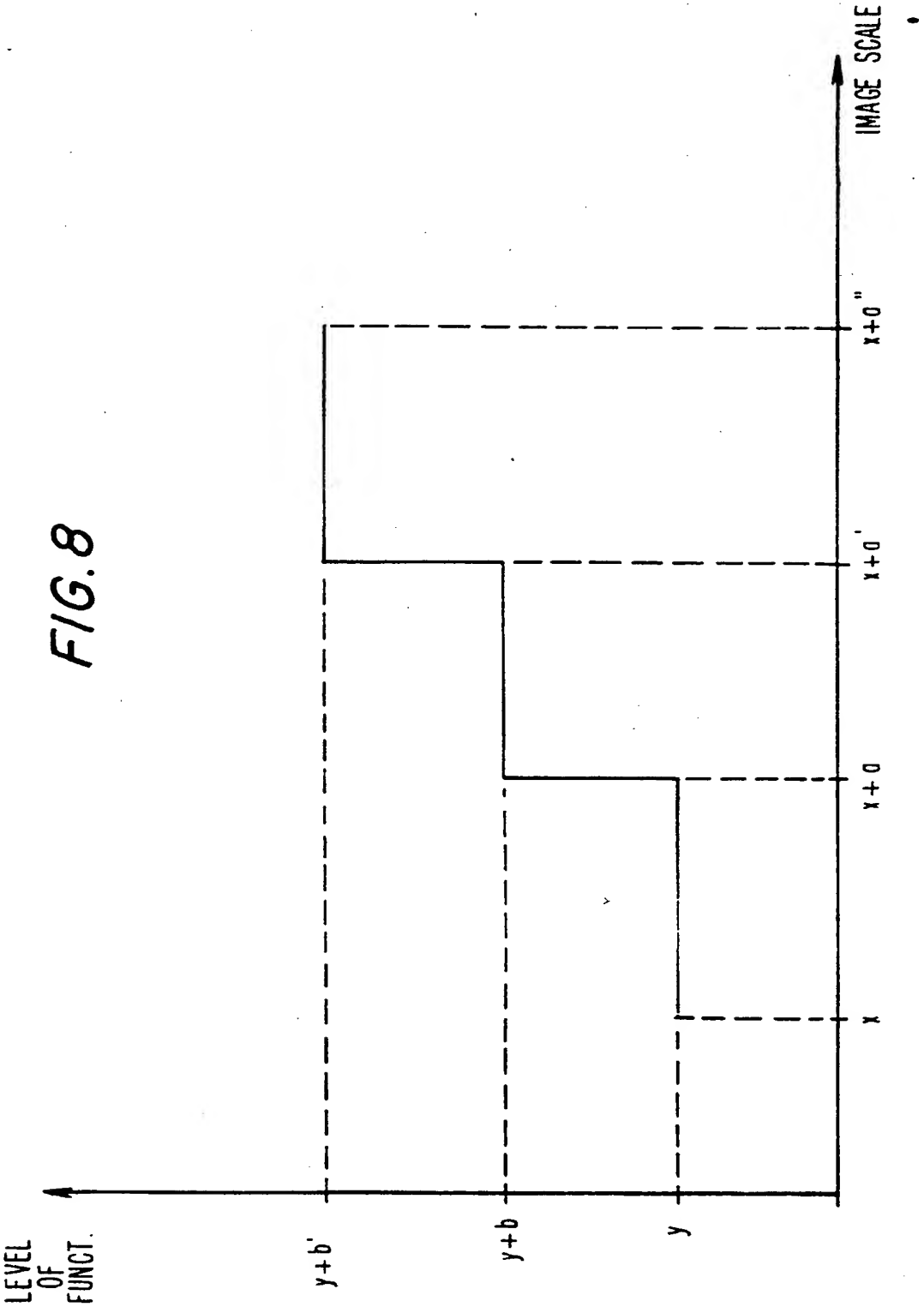


FIG. 7

FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/09830

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G06F 3/14; G09G
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 395/158, 157, 159; 345/115

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,475,812 A (CORONA et al) 12 December 1995, see abstract, see column 3, lines 33-39, 56-67, see figures 2A, 2B.	1-20
Y	US 5,129,055 A (YAMAZAKI et al) 07 July 1992, see abstract, see column 3, lines 45-53, column 2, lines 13-20.	1-20
A	US 5,073,771 A (SATTA et al) 17 December 1991, see abstract	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 05 AUGUST 1998	Date of mailing of the international search report 16 OCT 1998
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer RONALD LANEAU Telephone No. (703) 305-3973

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/09830

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

395/158